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Inquiry is a disciplined process by which individuals move from knowledge of concrete data to the formulation of abstract concepts. Television can serve the needs of inquiry, especially visual (as opposed to verbal) inquiry, if it can be made flexible enough to bring data into the classroom at the instant needed for making decisions or asking questions. Television will not replace the teacher because it cannot provide all the conditions needed to sustain the process of inquiry, but it can bring into the class room a pre-packaged and empirically validated instructional program. The teacher's task is then one of following up the television presentation by continuing inquiry in the classroom. Much imagination will be needed in designing effective instructional television programs, for the strength of such programs must lie in the stimulation of the thought processes within the learner, rather than in the pre-packaged presentation of a neatly and completely formulated explanation of all the data presented. Ideally, television should show the learner things he has not seen before, things that will make him sit up and take notice. To puzzle is indispensable. (RS)

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INQUIRY

IMPLICATIONS FOR TELEVISED INSTRUCTION

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edited by

Wilma McBride

for

The Division of Audiovisual Instructional Service

and

The Center for the Study of Instruction

NATIONAL EDUCATION ASSOCIATION
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The Need and The Problem

HAROLD E. WIGREN
Educational Television Consultant
National Education Association

OF INTERNATIONAL CONCERN TODAY is the pressing need to get individuals to think critically about their world. In education, this concern has centered on ways in which the schools can help children preserve their natural sense of inquiry in a culture that all too often puts a premium on conformity rather than divergence. How can the vehicles for teaching and learning, both within and outside the school, be focused to develop thinking children? This publication is intended to give insight into one facet of this concern, the design of programs for instructional television.

The seed for this publication actually was planted at the Second International Conference of Broadcasting Organizations on Sound and Television School Broadcasting in Tokyo in April 1964. Speaker after speaker touched on the importance of giving world-wide attention to television and children's thinking. The Conference Commission on In-School Television Broadcasting stressed several concerns:

- The need to bring new content and new methods, conforming with modern developments, into the curriculum of younger pupils through the medium of television.
- The need to run television courses for teachers on new teaching methods parallel with the courses on television for pupils.
- The importance of using television to stimulate children's activities to lead them to discover for themselves properties and relationships. Such teaching must start with the concrete (the real world of the child) and proceed gradually toward a greater degree of generalization and abstraction.
- The need to create a framework which invites the child to progress along a series of stepping stones corresponding with his thinking processes.
- The need to train the child in the methods of scientific thought, so that he will be led to make his own deductions from his observations of the screen and not simply to absorb information handed to him on a plate.

The discussions at the Conference also brought out the following points which underline still further the importance of using television as a means of stimulating children's thinking:

- Unless a program leads a child to inquire and experiment on his own, with the teacher's guidance, it has not fully achieved its objectives.
- We must beware lest our science programs on television become a kind of peep-show at which the child spectator is given a superficial titillation by being exposed to the wonders of science in a way which does not allow him to achieve even the beginnings of real understandings.

- Television has value and power to create a synthesis of what might otherwise remain separate facets of scientific thought and knowledge.
- We must make television an operational and dynamic learning tool rather than a static and verbal teaching instrument.

AS ONE ASSESSES THE CURRENT STATE of the art of instructional television in American schools, he is forced to conclude that the concerns which were expressed in Tokyo also plague us. To even the casual observer of the educational scene in the United States, far too many instructional television programs have been talking textbooks which aim to cover rather than uncover the subject. The focus has been too much on the dissemination of factual information and too little on the ability of the learner to arrive at conclusions for himself. All too often we have attempted to program answers for which the learner has no questions. All too often we have used inductive approaches in the classroom and deductive approaches on camera, allowing the setting rather than the learner to dictate our teaching methods.

In an effort to satisfy the needs expressed above and to examine our own programing in light of the Tokyo meeting, the NEA Division of Audiovisual Instructional Service and Center for the Study of Instruction co-sponsored, in cooperation with Stephens College, a Symposium to consider this topic in depth. The *Symposium on Inquiry: Implications for Instructional Television*[1] uniquely combined theory and practice by bringing together some of the nation's most knowledgeable learning theory and content specialists with some of the best practitioners in the educational television field—those responsible for the day-to-day programing needs of instructional television.

What seemed at first to be a strange alliance, considering that the two groups were at opposite poles when the conference began, grew to be a courtship in the months which have passed since the Symposium. The learning theorists needed more firsthand contact and exposure to television as a potentially valuable teaching-learning instrument; in turn, directors of instructional television needed new insights into the structure of knowledge, the nature of inquiry, and the ways in which learning takes place. Communication between the two did not really begin to develop until each had gone

[1] October, 1964.

home and had begun trying to relate to his own situation the ideas of the other. One result has been that several Symposium participants have experimented during the past year with developing program models which aim to apply the process of inquiry to instructional television.

So enthusiastic has been the reaction of the participants to the long-range value of the Symposium in influencing the course of instructional television practice that the Association has decided to make available in this booklet the papers presented at the Symposium, with the hope that this enthusiasm might be contagious and become a means of encouraging others to experiment in this direction.

In the midst of preparation of this booklet, the editors learned that two papers from another important conference were of immediate relevance to inquiry and television and were also available for publication. These were the presentations of Jerome S. Bruner and Chester D. Babcock given at the Brandeis Conference on the Economics of Educational Television.[1] Because it appeared unlikely that these two papers would be made available to a wide audience, it seemed important to the editors to obtain permission to include them in this publication.

This booklet represents an effort to examine the implications of inquiry to the design and structure of television programs as resources for learning. While inquiry training has sparked a far-reaching change in curriculum in many schools, bringing about a new approach to the teaching of mathematics, biology, physics, chemistry, and the humanities, it has made little if any noticeable ingression into instructional television. The result all too often has been that self-contained teaching packages have been designed for dissemination via television that lack relationship to classroom practice and need. If television is to become integral rather than peripheral to instruction in the classrooms of America it must become an exciter and motivator of learning rather than a tube through which capsules of information are poured.

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[1] *The Economics of Educational Television*, an unpublished report on the national conference held at Brandeis University May 23-26, 1963 under the sponsorship of the American Academy of Arts and Sciences, Brandeis University, and the United States Office of Education. Edited and with commentary by Ralph Garry. August 1964. The Morse Communication Research Center, Brandeis University.

This booklet is *not* intended to be a recipe book of how-to-do-it techniques which will build inquiry into instructional television programing; to attempt such would be to overlook or to miss entirely the philosophical basis on which inquiry is predicated. Nor are there any easy prescriptions or formulas which might be followed to bring about "instant inquiry." Only as we grow in our understanding of the ways in which children learn can we develop the ability to create situations on television which cause children to think and to develop concepts for themselves.

The editors have chosen to set this booklet up in inquiry form. In Section One, the first part, or data box, contains the presentations or raw data materials from the Symposium. The second part, or systems-structuring box, contains questions and discussion points raised by questioners in an attempt to handle and come to grips with the data. The third part, or application box, contains suggestions pertinent to the implications of the data for instructional television. In Section Two, other papers related to inquiry, but from conferences other than the Symposium, have been included.

INQUIRY

PART I / DATA

> **"Whatever one sees becomes a part of what he has already learned, if there is a place to put it in what he has previously learned. If there is no such place, then at that moment the highest form of inquiry can occur, because it is a moment in which one can create for himself new subsumers, new organizers."**

Teaching and Learning as Inquiry and the Contributions of Television

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EDUCATORS ARE IN A DANGEROUS POSITION. We are virtually surrounded by a tribe of cliches and slogans. These slick, simple, chrome-plated slogans—any slogans—are dangerous to you, personally, as men of careers, and they are dangerous to education.

The danger stems from what a slogan is: a complex and highly qualified idea which has been stripped of its complexities and bereft of its qualifications. A slogan is like the victim of a mad scientist in a horror movie: brains removed and replaced by a dime-store toy computer.

There are five major packets of these slogans: (1) learning by discovery, (2) problem solving, (3) teaching and learning by inquiry—a monster of my own siring, (4) concept formation, and (5) the process approach.

There appear to be only two things to do with slogans: recognize them for what they are and reject them; or, fail to recognize them as slogans and try to put them to work. If we take the first course—recognize them as slogans and reject them—whatever soundness and promise they may have had for education before they were "sloganeered" is lost; we miss the boat. If, on the other hand, we fail to recognize them as slogans and climb on the bandwagon, we face these consequences: we corrupt organized education; we give it another black mark to be identified by the next generation of critics; we give ourselves black marks as identifiable persons who contributed to a stupidity or fraud.

However, there is a third way to deal with a slogan—it is the only way to neutralize the dangers—and that is to give back to the slogan its brains, to read back into it, its complexities and qualifications.

It is to this large task that I wish to make four token contributions: first, to trace part of the recent history of the ideas behind the slogans—discovery, inquiry, problem solving, process approach—and in this way clarify their meaning; second, to look briefly at the scope and complexity of inquiry itself, not teaching and learning as inquiry, but inquiry *itself;* third, to instance what is meant by teaching and learning as inquiry; and, finally to suggest directions which television might take to contribute to the realization of teaching and learning as inquiry.

CLARIFYING THE MEANING OF THE SLOGANS

First, then, the history of the ideas behind the slogans. They have their origin in four factors: (1) our view of the nature of knowledge; (2) our view of the nature of the learning process itself; (3) our view of the nature of motivation for learning, and (4) the current state of a perennial battle between two views of the ends of education.

Our view of the nature of knowledge. Some forty years ago . . . perhaps thirty . . . perhaps twenty . . . scientific knowledge was supposed to be a collection of separate and certain facts, each of them discerned by patient and accurate inquiry. Inquiry was taken to mean merely looking, watching and recording. Our present view must reject the notion of science as a collection of sure and certain facts and substitute for it the realization that a body of scientific knowledge is a very complex organization, constructed to confer order and meaning upon facts. Furthermore, we now have to recognize that as the facts accumulate, there comes a time when they cannot be fitted into existing structures—the structures break; they are modified; sometimes they even are thrown out and replaced—and so scientific knowledge changes.

The change in our conception of the learning process. Forty years ago . . . or thirty . . . or perhaps even five years ago . . . the accepted view of learning, founded by Pavlov and publicized in this country by Watson and Skinner, supposed that learning took place through repetition, atomization, reward, and sometimes punishment. Furthermore, thanks mainly to Pavlov, it was supposed that one learns one thing at a time. This view went through one minor transformation—one in which we "sluffed off" the notion of reward and punishment and substituted the euphemism of reinforcement—but it amounted to much the same sort of thing.

Currently we have to face the fact that a very great deal of learning takes place not by mere repetition, not through being atomized, and not by reward, punishment or reinforcement, but rather by *organization* and *subsumption* of what is presented to us, under organized conceptions which are the products of previous learning.

Whatever one sees becomes a part of what he has already learned, if there is a place to put it in what he has previously learned. If there is no such place, then at that moment the highest form of inquiry can occur, because it is a moment in which one can create for himself new subsumers, new organizers.

It follows that teaching must involve some realization of what organizers and subsumers our students possess and what sorts of new learning are afforded haven in them. It also requires that we have some understanding of the possibility of misplacement (misunderstanding) of new learning under the "wrong" subsumer—information may be placed by some students under a subsumer where it fits, but which is not the one intended. In such a case the information may fail to be understood or may be misunderstood. In brief, we may no longer atomize curriculum with the single lecture and single proposition; what is presented must take its place relative to what has gone before and what may come later, if the teaching and learning are to be good.

However, to avoid sloganeering ourselves, we should remember that the older views were not wholly irrelevant to education. It is still the case that repetition and reinforcement do strengthen subsumers, organizers, and what is organized. However, we should keep in mind that a *given* set of subsumers and organizers stultifies the possibility of learning what is new. There is need for continued strengthening throughout all education of the presentation of stubborn and isolated facts which refuse to fit existing organizers and subsumers in a person's head. Facts which refuse to fit provide precisely the irritants that prevent the closure of systems of conceptions (organizers) and keep alive the possibility of constructing new subsumers and organizers.

Let us remember, too, that though learning may take place by way of organizers and subsumers, this does not necessarily mean that a vast body of subsumers should be mastered at an early age. To form concepts from early experience is to form them of limited experience—the younger the person, the more infantile the experience and consequently the more infantile the organizer or subsumer. Concepts need to be kept open, and many of them should probably come quite late.

The nature of the motivation for learning. In talking about learning, I have also talked about motivation, in part, but let us discuss it in its own right. The views on motivation began with the notions of pleasure and pain. They ran through the Skinnerian notion of reinforcement, and currently consist of the refurbishing of a very old notion: virtue is its own reward. I am using "virtue" in its original and pristine sense—the virtues were, and in this phrase remain, the names for *realized potentialities.*

What has been discovered, if one can call it "discovery" when it has been known so long, is that the event, the experience, the consciousness of engagement in actions which develop a potentiality is in itself one of the most invigorating, moving experiences which the child can have.

Self-realization, which is the heart of this matter of motivation, is cheapened out of existence as a motive by frequent and easy repetition. Concentrating upon self-realization carries with it the danger of running into the same kind of impossible, unreal self-centeredness that arose from misuse of the notions of permissiveness and readiness. Too, the notion of self-realization, taken by itself, ignores a great deal which we know about necessary and desirable forms of dependency; it ignores the need for parental love and approval; it ignores love and approval by peers, which is also potent; it ignores what every one of us has—a whole collection of security operations which require us to accumulate material tokens of effectiveness.

There is a mass of uninvestigated individual differences among men in what I shall call *ego strength*. Ego strength is of importance here because participation in an inquiry is not only an occasion of and an experience in ego growth, but also an occasion which requires a measure of ego strength. Children vary in the amount of ego strength they may have at a given time. How much of this variation is due to culture and educational deprivation and how much is due to genetic differences we do not know. However, it is the case that some children can take the highest flights of inquiry in stride and others are thrown into episodes of anxiety.

The current state of a perennial battle between two views of the ends of education. The fourth source of current ideas—the present state of the perennial battle between two views of education—we have virtually covered. The perennial battle has arisen out of a false opposition: on the one hand, the notion that education is the *imparting* of knowledge; on the other hand, that education is a process of *self-realization* ("self" does not mean that one does it by himself, but rather that what is realized is "one's self"). The fallacy of this opposition lies in the fact that one vital aspect of self-realization is the possession of a store of knowledge—an accessible store of knowledge.

We have gone a long way toward remarrying this divorce. We are getting away from talking about "content versus process," or "coverage versus self-realization." We know that if we are going to provide occasions for inquiry aimed at self-realization, they must be occasions in which the inquiry terminates in an addition to one's usable knowledge. And on the other side, there is no such thing as knowledge if all one has are facts—one has to have the *reasoned* facts.

On the basis of the originating sources, we come to some notion of what inquiry in the classroom means:

From our present conception of the *nature of knowledge* comes this facet of inquiry: the conclusions of scientific disciplines are either not understood or are misunderstood unless they are known in terms of what and how they are made.

From our understanding of the *learning process* comes further emphasis upon organizing conceptions which give knowledge its form and shape.

From our view of *motivation* comes a further facet to the notion of inquiry: the desirability, if not the necessity, of providing occasion, stimulus and scope for contribution by the student to the content he is to learn.

Finally, from an intelligent *union* of self-realization and knowledge comes this facet: the value of minutes spent teaching is to be measured not only by the number of problems and propositions which can be parroted by the student in consequence, but also by the fruitfulness of the occasion for ego growth. How can this be measured? That is a problem for the future, but those of us who get involved in inquiry can begin to make some rough estimates.

THE SCOPE AND COMPLEXITY OF INQUIRY ITSELF

I turn now to a suggestion of the complexity and scope of inquiry per se—the original inquiries of the disciplines, of which classroom inquiries should be imitations. I have so far refrained from a definition of inquiry, because in this direction lies a return to a slogan. However, I am tempted now to do what I have refrained from doing:

> Inquiry is a *disciplined* movement from a starting point and by a pathway to an appropriate end.

The starting point, pathway and end are not always and everywhere the same, however. They are radically different in the humanities as against the sciences, for example. Indeed, they cannot readily be described as separable into a mere three or four classes, but a rough grouping is helpful and I shall risk sloganeering by listing five of the radically different groups of inquiries which can take place.

(1) There is inquiry characteristic of the sciences. This is inquiry whose aim is to *understand* and whose dual starting points are a natural subject matter and a conception of it. A scientific inquiry, therefore, is a process which moves from a particular subject matter and a particular conception of it to an understanding of the subject matter. The process differs as the subject matter differs and as the conception of it differs.

(2) There is a second chunk of inquiries which belong to disciplines which I shall call axiomatics. This group can be illustrated simply and properly and in ordinary language by saying: Mathematics is not a science; it has no subject matter; numbers have no existence; shapes have no existence; algebraic equations do not inhere in any matter—they are not discovered in that way. Rather, mathematics is the outcome of a process of exploiting a set of conceptions by means of an agreed-upon set of rules. Mathematics and many economic systems are of this sort—they are axiomatics, not sciences.

(3) Third, there is humane analysis. The inquiry of the humanities has as its outcome not understanding, as in the case of science, but *appreciation,* which means not mere liking, but grasping and adding to. In this kind of inquiry, the starting points are all the elements of which art objects are composed; in lyric poetry they are imagery, music, the sound of words and letters and even the look of them upon a page; in the case of the short story or drama or novel, the starting points are diction, characters, action and plot. The outcome is an appreciation of the artfulness with which these multitudes of elements fit one another.

There are two patterns of inquiry radically different from all of these, because the three groups just mentioned are in some sense inquiries *to* a principle (beginning with scattered parts, they end up in a formulation . . . a whole poem . . . a whole short story . . . a whole theory or some usable fraction of it. The other patterns are inquiries *from* a principle, and there are two of them:

(4) Call one of them *engineering*—this is the wide range of *application of principles.* To take just one example from this vast inquiry group, we know that bodies fall at a constant acceleration;

what would be the terminal velocity of a particular falling body at a particular point? Finding the answer involves inquiry which identifies and applies various engineering principles.

(5) The fifth pattern—the inquiry most vastly ignored by the schools—is the group called *prudence.* (Webster: cautious practical wisdom; good judgment; discretion.) This is an indispensable kind of inquiry for applying a *moral* principle or a value to a particular situation.

TEACHING AND LEARNING AS INQUIRY AND THE CONTRIBUTIONS OF TELEVISION

What can television do by way of transferring teaching and learning from inquiry?

First, what can we do generally in the classroom? We can distinguish three classes of teaching and learning experience:

(1) The easiest for the teacher, but not without its usefulness, I shall call simply "received" patterns of inquiry. If one examines the ordinary textbook or, I suspect, the ordinary TV presentation, one finds that it consists entirely of a *rhetoric of conclusions.* That is, its every sentence is a declarative sentence. It says, "This is x and that is y and x is y over 2, and if you put this together you get that, and there are sixteen classes of so and so, and such and such is 33.4, et cetera." That is a rhetoric of conclusions.

In contrast, there is a pattern I shall call *narrative of inquiry.* Narrative of inquiry replaces the "facts" presented by a rhetoric of conclusions with *reasoned* facts. It is the style of discourse in which one says, "Given this conception, this problem arose, and so-and-so found these data when he did this experiment and as a result he concluded thus and so. However, B came along and saw that by doing this experiment, so-and-so had also inadvertently done something else, so B did a second experiment and got different data and revised the original conclusions of so-and-so by so much. Then C made a totally new attack upon the problem; with a new conception, he did a quite different experiment . . ." That is narrative of inquiry; it exemplifies the merely receptive pattern upon which a teaching-learning experience is based, but at least the students are receiving the reasoning along with the facts.

The "received" pattern of inquiry is easy for TV as far as the medium is concerned, but in another sense it is difficult insofar as resources are concerned. The specialist who can write the TV script is unlikely to be the same specialist who can produce the narrative of inquiry.

(2) The second kind of teaching and learning experience I call "participative." The participative kind is best illustrated, I think, by imagining a dialogue. Here is the evoker, the educer, the teacher, and here are the children. The educer, the evoker, says, "Take a look at this, and let's see what we make of it." There are two or three alert, free youngsters with enough ego strength not to care about being wrong, and they start talking about it. If the teacher is good, he does not say to the student, "You are wrong"; or "You are right." Instead, he honors the contributions that are made even if they are mistaken, by helping the giver see what he has left out by way of the data, what unwarranted assumptions he has made, or what he has not taken account of. So honoring, he treats him like a man—and every man can be mistaken.

The difference between the "participative" and the "received" forms of inquiry should not be merely that the participative is more dramatic than the other. If that should be all the difference, the one will perhaps be more fun, but it will still fall into the classification of the received pattern. In the case of a TV program using the above situation, the student viewers may participate by anticipating what the dialoguers will say; they may become upset when the dialoguers say something that they can see is wrong; they may itch to get out of their seats, and they may yell at the TV screen.

(3) The third pattern of teaching and learning by inquiry I shall call "active." This kind of experience consists of posing questions or situations which move the student to speculation, to interpretation, to hopeful ways of testing speculations—in short, which move him to follow through the pattern of inquiry appropriate to that subject matter and that principle, terminating in a reasonably good facsimile of the product of the original inquiry.

I have distinguished three classes of inquiry situations—the received, the participative and the active. They are arranged in order of their *decreasing* role in television; that same order is the order of *increasing* importance of their potential contribution in television.

The received form of teaching and learning experience in which one presents a narrative of inquiry is relatively easy in television in terms of our past technical habits. In the participative and the active patterns of teaching and learning by inquiry, there is less that TV will do, but it becomes more important. There are not many classroom teachers who have the freedom and the confidence and sufficient basic content grasp of their materials to risk the open-ended situation which depends upon what the students do next—the typical classroom teacher cannot do it. This is the really crucial way in which TV can contribute.

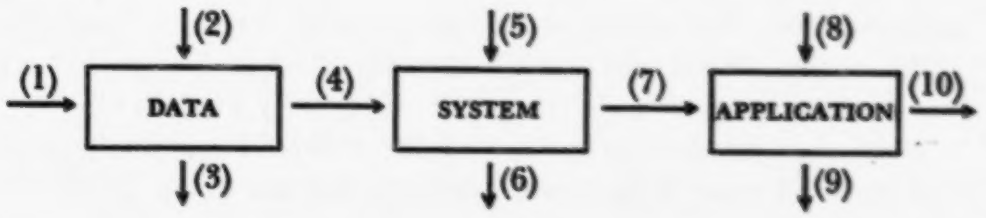
data data data data data data data

> **"Missing in most classrooms**
> **is availability of raw**
> **data and the freedom to use**
> **such data to build theories.**
> **In a word,in most classrooms**
> **we are not giving the child**
> **a chance to inquire."**

The Pattern of Inquiry

J. Richard Suchman
Officer in Charge,
Division of Elementary and
Secondary Research and
Acting Officer in Charge, Division of
Higher Education Research, U.S. Office of Education

THE PATTERN OF INQUIRY, in terms of what takes place in the classroom, follows this kind of a framework:



DATA

First we have the "data" box; by data, I mean informational intakes, specifics. What takes place in a classroom with respect to data? What can happen, what are the possibilities?

Arrow (1) The child can take in something directly. He can, let us say, see a turtle or a goldfish in a bowl: he can *perceive* something *directly* and thereby take in data.

Arrow (2) The teacher can verbally *feed data* to the child—tell him about something.

Arrow (3) The child can *report data* that he has received or has retrieved from storage.

SYSTEMS

Let us move over another step in the framework of inquiry to the "system" box. Data do not exist for their own sake necessarily—things can be done with them.

We ask the child to take in data and do something with them, and so we come to systems or structures, ideational patterns, ways of handling data:

Arrow (4) The teacher can ask the child to try his hand at building a system for himself, based upon data taken in.

Arrow (5) The teacher can direct the construction of a system through didactic expository methods. Through the manipulation of data and symbols, the teacher can engineer conceptual growth.

Arrow (6) The teacher can ask the child to report the systems he has, whether the child built them autonomously or with the teacher's help.

As an example of the three different kinds of operation that can take place with data in the classroom, suppose the teacher has a tank of goldfish. He can ask the child, "What is in the tank?" The teacher lets the child look and the child can *take in* data by seeing what is in the tank. Suppose the teacher says, "How many fish are in the tank?" When the child responds, he is *reporting* data. Suppose the teacher says, "What color are they?" and the child replies, "Gold and black"; if the teacher then says, "There are green fish, too," he is *feeding* data verbally to the child.

Now, suppose the teacher says to the child, "Look in the tank and think of what is in there; what can you say about goldfish?"

A child says, "There are at least two kinds of goldfish—gold and black." The child is beginning to *construct a system;* he is making a general statement about goldfish, based upon data that he has taken in. He could make a more sophisticated statement—he could say that goldfish swim with a kind of swishing motion, for instance; the child is observing concrete, specific instances and from these he is beginning to construct a general statement—that is the process of using data to build a system.

To go to a more complex example, let us suppose that the teacher says, "What can you say about goldfish?" The child responds, "All goldfish are less than two inches long." The child is basing his statement upon the fact that none of the goldfish in the tank is longer than this; the teacher knows from his own experience that this is a premature conclusion, but he lets the child, at one stage of the game, at least, use his own data and build systems for himself. The teacher can later show the child that it is unreasonable to assume that the only data available are those present, and that therefore no conclusions can grow out of these—that is a matter for later discussion. Unless the child is given a chance to form his own systems, he will never learn the logic involved.

APPLICATION

The final picture in the sketch is the "application" box—systems can be *used (Arrow 7).*

Application of systems is essentially the kind of thing we have done in mathematics for so long. Axioms can be taught as a system of rules, and the child in the old math was taught how to apply these axioms so that if he knew what to do, knew the rules to follow in addition, multiplication, division and subtraction, he came out with the correct answer. In the old math we did not give the child data and have him try to build a system; in the new math, this is one of the innovations—we start with the data and have the child get involved in system building, rather than give the child systems and have him get involved in applying them.

To complete the picture, the teacher can also verbally feed in applications *(Arrow 8)* such as "how to do" something; or the child can verbally present his application *(Arrow 9)*—what he could do under the circumstances to apply a system—or the child could make the actual decision and take action *(Arrow 10).*

THE HEART OF INQUIRY

As we analyze teachers and teaching situations within this framework, we find a tremendous emphasis upon the *intake, storage and retrieval of systems.* The teacher gets the child to take in generalizations directly from lectures and textbooks, through television programs, motion pictures, and other media. The child is asked at some later time to retrieve the systems that he has presumably been storing as a result of the intake.

We find teachers spending a great deal of time trying to *build systems* with words and then getting the child to regurgitate these systems with the same words, often not really understanding either the origin or application of the systems.

We find teachers *feeding the systems* to the children and then asking them to apply them in some practical situation, either through decision making in real situations or through verbalized hypothetical applications.

Rarely are children given the opportunity either to build or test a system. Missing in most classrooms is availability of *raw data* and the freedom to use such data to build theories. In a word, in most classrooms we are not giving the child a chance to *inquire.*

In inquiry, we start with what is concrete and problematical, and if we cannot fit this into what we already understand, we try to build new systems through the process of gathering additional data and combining it—taking the models we already have and bringing them to bear on the additional data.

Inquiry is a cyclical thing, if we let it happen. We show the child something strange, new and puzzling; he brings to bear the systems or models he thinks are relevant. He is not bankrupt to start with—he has a store of conceptual models that he has been building up throughout his lifetime. He may not have an adequate model to account for a given discrepant event, but he may have many models which have relevance to him for this event. He may have models which, if they were combined appropriately, could add up to a fairly meaningful explanation of the event.

The child starts out without knowing which models are relevant or how to put them together. He does not know which ones will work and which will not. This, then, is a matter of trying out little pieces of ideas and gathering data to test these ideas—rejecting some, keeping others, rearranging them—until he has built a large complex model that enables him to make an accurate prediction or to explain the strange and new and puzzling event in a way that is satisfying to him.

CONDITIONS NECESSARY FOR INQUIRY

How do we create the environmental conditions by which the process of inquiry can be facilitated—in other words, how do we create the conditions for inquiry in the classroom?

Three conditions seem to be essential for the process of inquiry to take place:

(1) There must be some kind of *focus*. Merely saying to the child, "Think about it," does not provide focus. The child must be drawn into a recognition of his own perceived discrepancy.

For example, one might say, "Look at this and watch what happens," and then show the child something which he could not have predicted and has no way to explain—something that is generally puzzling. Then, if we say, "How can you account for such a thing? . . . Can you think of any kind of a theory that would make this a sensible event?"—we then have given a focus. We have confronted the child with a *discrepant event*. He perceives something for which he has no direct corresponding conceptional model; there is a gap.

When a child is confronted with this kind of a gap there is a motivation to close it. He does not passively perceive things for which he has no appropriate conceptional model; he likes to feel that his cognitive map of his world corresponds to reality. Therefore, when he is confronted with a portion of reality for which he does not have the appropriate map, or when the map that he has actually leads him to predict erroneously, he is disturbed—and often disturbed enough to inquire.

(2) Some kind of focus is necessary, and it is helpful to have an event that is discrepant, but that is not enough to facilitate inquiry. Actually, if that were all there were to it, television as it

exists today could be used as a way of presenting discrepant events to mass audiences and stimulating inquiry in every home and classroom. A second condition necessary for inquiry is *freedom.*

Freedom is probably the most important condition of all. Without freedom there can be no inquiry. When a child is being led step by step down any particular learning path, that, by definition, is a limitation of his freedom. For inquiry, the child has to have the opportunity, the autonomy, to make choices as to what data he gets next and what ideas he pulls out of storage to try out on the data he takes in.

There are two elements involved in freedom. Call one *external.* We say to the child that he is free to ask whatever questions he wants, to gather whatever data he wants, to move in whatever direction seems to him to be appropriate. In other words, no program is going to lead him—he must write his own. When we create these conditions, the child does not necessarily respond with complete autonomy. He may be too dependent on somebody to take the lead.

Too much freedom all at once can be hard to handle, so the second aspect of freedom has to emerge in time. Call this *autonomy*—the willingness and ability to utilize freedom, and to use it in the pursuit of a goal.

So the one element involved in freedom is the external, the freedom granted by environment; the other element is the autonomy, the accepted and utilized freedom. Both elements should be considered; but the second one develops over a period of time. The child has to have great opportunities to inquire freely before he really accepts the fact that he is free to inquire, that he does not have to conform to anybody's expectation.

Hampering the growth of autonomy is the concept of "right" and "wrong" and the expectation that reward comes from being "right." Teachers often put the whole dialogue of education within this context. (The conclusions—the rhetoric of conclusions—are there to start with, and if the child has the right conclusions he gets a reward; if he has the wrong conclusions—the conclusions the teacher does not approve—he gets no reward.)

Actually, it is epistemologically weak to speak of a "right" explanation or theory; there are hierarchies of theories and explanations which have increasing degrees of power. A powerful theory can be used to predict, control and explain in a way that is meaningful and useful. The power of a theory can be measured by the percentage of accurate predictions and controlled outcomes. When a theory is used in an explanation, the measure of its power is another matter. If the explanation seems to be meaningful and seems to make sense, and if it seems congruent or at least compatible with other theories, one retains the theory until he finds new data that upset his faith in that theory. If a theory does not have the power just described, it can be rejected as weak or invalid. This concept can be made much more meaningful to children than the very arbitrary notion of "right" or "wrong."

(3) The third condition for inquiry is a *responsive environment.* In a responsive environment, if a person needs information or has an idea, and he reaches out for specific information or for response to his idea, he can get it. In inquiry, the child decides what operations will be performed; he uses the operations to make the environment respond to him. He cannot inquire except through gathering data. If he does not have an environment from which he can obtain the data that he wants, when he wants it, and in the sequence in which he wants it, there can be no inquiry.

TELEVISION IN AN INQUIRY-CENTERED CURRICULUM

Where can the television medium come into the pattern of inquiry in the classroom?

The necessary conditions for inquiry can be provided only in part by television; the major contribution this medium can make is in providing the focus. I do not see where TV by itself can give the child freedom to inquire—television does not set the classroom climate; nor do I see where TV can provide a responsive environment.

Television can serve the needs of inquiry and teaching if it can be made flexible enough to bring data into the classroom at the instant they are needed and wanted. An inquiry-centered curriculum is not an unreasonable thing, and there is an important role for television in such a curriculum, but such a curriculum would demand tremendous changes in the organization and use of TV facilities and programing.

We borrowed from commercial television certain ideas about what constitutes a program, and we have not shaken free from these concepts. We have to throw away these shackles and start with an open mind. Television should be a tool in the hands of the teacher; he must be free to select from the widest possible range of offerings. Classroom programing should allow the teacher to pull from the TV fare the things that fit into the kind of teaching he wants to do.

The key person in any classroom inquiry situation has to be an individual who can create the necessary conditions at all times. There must be someone on hand who can sense what needs to be done in terms of where the children are and what kinds of goals there are, and take care of decisions that have to be made on the spot. There has to be someone in the classroom who can sense what questions should be raised next, what kinds of data should be thrown into the picture, and where things should be shifted to make possible further learning situations. This must be a person who is there on the spot to diagnose individual and group requirements and progress in light of educational goals. Only the classroom teacher can perform this function.

Any system that fails to put the classroom teacher in a diagnostic, responsive role cannot generate inquiry and will hardly promote any worthwhile learning; there is no teacher-proof learning system. Children differ, classrooms differ, group characteristics differ; every child is unique. The teacher must be there to make room for individual differences and to create a learning climate that is differentially responsive to differing individual requirements and changing group requirements.

Television can trigger inquiry, but it cannot provide all the conditions needed to sustain the process.

"... postholing ... we probe deeply and exploit certain areas entirely, so that we will have a study in depth, the impact of which will last for a longer period of time."

Visual Inquiry

QUENTIN BROWN
Producer, Social Studies
Curriculum Films, Educational
Services, Inc., Watertown, Mass.

IT SEEMS TO ME THAT INQUIRY, from the time we started talking about it at this conference, turns out to be something verbal; we have assumed that there is a "grammar of inquiry." I am a little surprised that television people can be hoodwinked into talking about inquiry as verbal. *Inquiry can be visual.*

There is a legitimate kind of inquiry where we inquire visually into the broad context in which conclusions are arrived at not by some shop-logic grammar, but by a broad enough view that things themselves are self-explanatory. This appears to me to be the very basic type of inquiry that television is adequately suited for.

Educational Services, Inc., is only on the threshold of making films for social studies, but we are standing on that threshold with a lot of convictions about what we should be doing in this field and how we should be going about it.

An aspect of our social studies curriculum is the *postholing* idea. This means essentially that we probe deeply and exploit certain areas entirely, so that we will have a study in depth, the impact of which will last for a longer period of time. The ESI social studies curriculum is planned so that the students see major segments of film every three to four weeks and use these as raw data, with supplementary smaller loops as raw material, for discussion. Initially we know that appreciation by the students is going to be superficial. But as they see one unit after another, there may come through to them an idea that there are certain things which are always going on; certain general ideas may come through. There are ideas below the surface which we hope they will gradually pick up. It is not to be hoped that all these will become verbalized in any way at the beginning, but as the year progresses we hope these common denominators will begin to come through.

ESI has set up a national committee—the Social Studies Curriculum Committee. What impact their recommendations will have upon the curriculum of the nation's schools is not obvious at this point, but a new social studies sequence is emerging as a result of this study group. In ESI's social studies films, we believe firmly that it is important to have inquiry built in, but we do not begin with a method. We begin with a subject—an area of subject matter; with the scholars that direct our work, we try to keep it as rich a representation as we can.

Educational Services recognizes a problem which has come up also in this meeting: How do you reach elementary school teachers all across the country? You cannot go to them personally; it is just impossible; there is not the time. So how do you get to them, give them a feeling for what the new ideas are, and present to them the new methods of working with children? To this end, we believe that film has a considerable part to play.

For instance, the inquiry pattern is strange to many elementary school teachers, and it is felt worthwhile to get it onto film. The technique of using one of these filmed units in teacher-training is to give teachers an idea of what inquiry can do and how teachers can draw out of students the things which are important—how to get this kind of activity going.

Another aspect of the use of educational film is that it can take students into an honest facsimile of an experience which they are not likely to have otherwise, or which they cannot get in any other way, and take them in with a sufficient sense of reality that they are totally convinced that what they have seen is, indeed, the case. Some of the film footage for ESI's elementary science program takes off from the laboratory work which the children are doing, to let them see more clearly something which they had begun to see on their desk tops or on their lab tables.

One of the programs that we have afoot is the production of films for fluid mechanics, college level. Fluid mechanics happens to be a field where at the moment almost all of the teaching is done on the blackboard with mathematical formulas, yet it is also a field in which much that the student learns is, indeed, visible in some way under special circumstances. These special circumstances are very difficult to create, even in college laboratories, so we are simply providing with film the tool by which the student can have an intuitive feeling for what goes on, in addition to understanding the mathematical model on the blackboard.

Sometimes the business of getting students from one plateau of understanding to another in a discipline is fairly easy and follows a fairly steady line of progression, up to a point. Then the class gets to a knotty problem which everybody is uneasy about that they skip around and avoid. This is where turning to someone who can make the statement, who can make the bridge—bringing this person into the classroom in some form—is a tremendously worthwhile thing: this is another use for film.

People actually working in the disciplines can be put before the students by use of film, and we have felt that this is a useful thing to do.

Film can do a terrific job of putting source material in front of the students; this is something which has become increasingly clear as we move into social studies. Our social studies films are designed not to tell the viewer something, but rather to present data that can be presented best on film. Some of the films will have the function of conveying, in as inductive a manner as possible, the concepts and generalizations around which contemporary social science is organized. Much will be left for students to piece together and figure out for themselves.

Most, if not all, of the comments made here on visual inquiry in film have equal validity for instructional television.

"... video-taped lessons that are 'guaranteed' to teach what they have been designed to teach."

Empirically Validated Instructional Television

P. KENNETH KOMOSKI
Associate Executive Officer,
Institute of Educational Technology,
Teachers College,
Columbia University

THE INSTITUTE OF EDUCATIONAL TECHNOLOGY has undertaken a project to investigate how the television medium can be more thoroughly exploited by using instructional techniques borrowed from programed instruction. The project is sponsored by the Media Branch of the USOE and is being carried out with the cooperation of WETA-TV, Washington, D.C.[1]

The program is concerned with creating what the Institute calls "empirically validated instructional television." We are trying to create six video-taped lessons that are "guaranteed" to teach what they have been designed to teach. We are hoping to do this by constantly revising our instruction until most students (the lessons are designed for use with 6th grade classes) can readily achieve criterion performance on a post test.

[1] This project will be completed in June, 1966. A full written and filmed report will be available from the Institute soon thereafter.

The three critical terms which we use to describe these lessons—*instructional, validated* and *empirically*—may be defined as follows:

The term *instruction* we consider to be the process of bringing about predictable changes in behavior; within the range of this project we are concerned with television as a direct instructional technique. By *validation,* we mean the process of establishing the extent to which specific behavioral changes occur in the learners as a result of the instruction we have designed. We use the word *empirically* because we believe we can best bring about predictable changes in the behavior of the learner if we develop a sequence of instruction and then encourage learners to interact with this sequence of instruction by requiring them to make overt responses to specific questions put to them during each lesson.

On the basis of the responses made by the learners, we revise, revise, and again revise the instruction until we are able to establish empirically that learners, in fact, perform in a way we "predicted" they would. In so doing, we believe we are introducing to television programing one of the most important techniques of programed instruction—the shaping of each step of the instruction by the learners we are trying to teach. In doing this, we begin by creating a behaviorly stated set of objectives and translating them into a criterion test which is used to measure our success.

Before a lesson is tried out on students, we also ascertain whether they already know what is contained in the instruction. After determining that the students know enough to get into the lesson, but not what we hope to teach them, we have them go through the videotaped lesson. We then test them again to see whether, in fact, we have achieved what we set out to achieve.

The subject matter we are working with in this television project is an introduction to human geography for sixth grade students. The program, however, is not a curriculum project, but a demonstration of how to develop empirically validated television lessons. Our hope is that the techniques we are working with may be applied to a wide variety of subject matters at all grade levels.

One of the most important aims of this project is to document our experience in such a way that others may benefit from it and readily test the techniques we are developing. In our opinion, the production manual which we hope to develop may well be a more important outcome than the six video-taped lessons in human geography that will be created.

So far, we have not had a teacher present on the screen. Rather, we have used films, slides, and many still and animated drawings. One of the project team has come up with an imaginative low-cost animation technique which will also, we hope, be an important outcome of this project. Because of our commitment to use TV's great and often unexploited potential as an audiovisual medium, the "teacher's" voice is heard *behind* these basically visual presentations. As one of the sixth graders put it: "When the teacher talks we are not looking at him—we are looking at what we're supposed to be learning."

Another important aspect of this project is the fact that the method of instruction we are developing is emerging from a fruitful interaction between a subject-matter expert, programers concerned with the instructional process, visualists, animators, and television technicians.

Our approach to the analysis of our subject matter has been to identify and analyze certain important concepts that the human geographer uses to organize his data. We are also integrating into our lessons procedures that geographers follow in organizing data. Some of these are quite straightforward, and therefore we believe that they can be taught efficiently in a more or less linear programed fashion. We are not, that is, primarily concerned with teaching through inquiry. However, we do teach almost entirely in a questioning, or interrogative, mode. Some of the behavior the human geographer engages in may indeed be characterized as inquiry. When this is the case, we are hard put to make the television medium and our programing techniques bend to these purposes. However, we think we are gaining some insight as to how to do this.

It is difficult to outline what attempts might be made to teach on television by using the method of inquiry. For the present we are concerned more with establishing a basic understanding of important concepts which, to our way of thinking, underlie any intelligent inquiry into problems of human geography. A human geographer does have conceptual frameworks he uses and procedures he follows as he organizes data and forms hypotheses.

In a sense, then, we are saying that inquiry may be more fruitful if students have mastered a basic understanding of the fundamental concepts within a particular discipline. I think that the kind of work we have been doing on this project will enable us and others to teach the underlying concepts of various disciplines well enough for children to begin using them with confidence at a very early age. I think, further, that there will be certain procedures we shall be able to teach well which will prepare students for dealing with data in the way in which an inquiring scientist does. But, in order to do this well, we shall probably have to supplement the linear approach with new forms developed especially for television and other group-paced media which will enable students to deal with unstructured situations into which they can successfully inquire—by using the concepts they have mastered via the more programed lessons.

We have, in fact, been led to suspect that teaching the concepts through which data may be organized may in the long run lead to more productive inquiry than could be accomplished without mastery of the concepts. Inquiry is, after all, a set of behavioral patterns, and if we recognize it as such and can analyze these particular behaviors and their relationship to other behavior, we should be able to teach inquiry as efficiently and effectively as we teach other behaviors. The trick is in analyzing what we mean by "inquiry."

Thus far, our project has been concerned with the easier task of teaching such concepts as "population," "environment," "technology," and "social organization." Our job is to teach these and to establish empirically that we have taught them well. If we succeed, it will be first of all because we have done well at analyzing these concepts and have then intelligently used what we know about both programed instruction and television to implement the mastery of these concepts by sixth graders.

Having succeeded at this, it would indeed be a challenge to find a way to help youngsters use these concepts better by training them to inquire into and solve various "problems" in human geography.

INQUIRY

PART II / SYSTEMS-STRUCTURING

Is inquiry a process or a product?

Inquiry is a *process* by which individuals move from the concrete to the formulation of the abstract.

Both process and content are important in the function of the school, but we have neglected process.

One of the biggest problems we face in education is to decide to what degree we can let go of our insistence on specific concepts of a curriculum for the sake of developing the ability to think.

My concern is that the child learn what inquiry is all about—that he get the kind of attitudes and self confidence necessary to take data and build and test theories.

J. Richard Suchman

Why TV for the narrative inquiry?

The number of people who can do the job of constructing a narrative inquiry intelligently and responsibly, in their respective fields, is few. The typical teacher cannot do it. Consequently, the school system which has the resources and the location to get the people to do this job on tape for television is supplying the classroom with what it cannot otherwise get.

Joseph J. Schwab

What has happened to the textbook?

Nothing has happened to the textbook. Simply because we bring in a new approach does not mean that everything that has been done in the past will be thrown out.

Make the things that television can bring into the classroom—information and scholars of the area—more germaine by bringing them in at the instant they are needed and wanted.

The teacher becomes an organizer of intellectual resources—one who facilitates inquiry in the sense that he helps the child find the things that he needs in the course of inquiry.

J. Richard Suchman

Is the old rule of starting with the familiar and working toward the unknown outmoded completely?

We do not start *with*; we start *from*. Let us distinguish between diffusion, confusion and the puzzle. To confuse is pretty bad; to puzzle is indispensable.

I would rather see the television medium used to show the child things he has not seen before—things that will really make him sit up and take notice.

Joseph J. Schwab

When dialogue is transferred by television into the classroom, how does participative inquiry take place?

The dialogue taped for television becomes participative in the classroom when it evokes a kind of sub-vocal replacement of the students on the screen by the students who are watching.

The stage must be set by the teacher in the classroom, using data materials, supplementing with TV, then following up the TV presentation by a continuation in the classroom.

Joseph J. Schwab

How can teachers be encouraged to take over the use of the television medium?

We encourage teachers to take over the medium by programing so that they can make flexible use of TV. The only way for us to approach the application of TV in a classroom is to start with an open mind. I react to sticking rigidly to a format—to a beginning, middle and end type program. We might dispense with audio for awhile, or turn off the transmission for ten minutes . . . get the children involved, and at the same time give the teacher enough background that he can take the initiative and make the best use of the discussion time.

J. Richard Suchman

What about in-service use of television for teaching inquiry itself?

Starting with the teacher is a very good place. I can see no reason why television cannot be used in education to share among teachers new techniques and approaches, much as other professions are presently making use of television for this purpose.

Teachers respond readily to a concrete demonstration of ways of working in a classroom. But a demonstration is not enough; it has to be followed by a discussion; this in turn has to be followed by opportunities for the teachers to try the technique themselves, under supervision.

J. Richard Suchman

DISCUSSION /

I have noticed that TV tends to go in one direction and the curriculum in the other. We need to find ways to build bridges from one to another. It is really no wonder that many curriculum people take a dim view of instructional television—we have never adequately demonstrated to them the possibilities . . . the ways of using the medium. We need to help open up new fields in the use of instructional television.

■

Best results will come from interaction of curriculum people with television people. I believe we should involve ourselves as curriculum stimulators when necessary, as curriculum coordinators when possible.

■

We need to develop a new perspective, a fresh approach. Too often on television the inquiry is that of the teacher and not of the youngsters. We need to learn the importance of children doing the inquiring. We need to have less teacher on the screen and better use of the visual as an instrument.

■

The stimulus for me has been, "Go back and see just how much inquiry there is in our programs and what can be done about it." However, it is dangerous if we go home feeling that inquiry is a brand new idea and has never been done before.

■

Another gap that we need to bridge is in communication between the television studio and the classroom teacher. We need to learn from the teacher what to put in our manuals.

■

This group could serve as catalysts . . . agents . . . investigators . . . coordinators . . . to see that inquiry is given honest, serious study, while we remain in our basic roles of service and implementation of the school's programs and purposes.

■■■

INQUIRY

PART III / IMPLICATIONS FOR TELEVISION

SUMMARY /

Joseph J. Schwab

The narrative inquiry, in the receptive pattern, lends itself well to the presentation on television of persons better equipped than the typical teacher in their respective fields.

The participative pattern of inquiry has importance for television in that a dialogue on the screen can evoke in the classroom viewers a sub-vocal participation, to be followed by verbal participation in the classroom.

For the active pattern of inquiry, many provocative situations may be transferred to the student by television; these situations might otherwise be too inaccessible, too large, or too expensive to import into the classroom.

SUMMARY /

J. Richard Suchman

Television must be made flexible, at the expense of traditional programing on open circuit TV, if it is to bring into the classroom the information and scholars that are needed, at the moment they are needed, in the course of inquiry.

The necessary conditions for inquiry can be provided only in part by TV, and the major part is the focus. One approach might be to dispense with audio or to turn off the transmission so that inquiry can take place after data has been brought into the classroom by television.

Television has value for in-service use to share among teachers actual demonstrations of new techniques and new approaches.

SUMMARY /

QUENTIN BROWN

Inquiry can be visual as well as verbal, and visual applications appear to be the basic type of inquiry for which television is adequately suited.

Educational film, which is readily transferrable by television to classrooms, can take students into an honest facsimile of an experience which they are not likely to have otherwise, with a sufficient sense of reality that the students are totally convinced that what they have seen is indeed the case.

Educational film also has a considerable part to play in helping to give teachers a feeling for new ideas and in presenting to them new methods of working with children. The inquiry pattern is strange to many teachers, and filmed units have been produced to give teachers an idea of what inquiry is and demonstrate how to get this kind of activity going in the classroom.

SUMMARY /

P. KENNETH KOMOSKI

In using television as a medium in the field of programed instruction, it is possible to empirically validate the instruction—predict and guarantee that students will in fact learn what is taught.

To date, in the program reported, inquiry has entered in not specifically as something taught, but rather as something prepared for by developing a basic understanding of the fundamental concepts within a subject.

It is theorized that inquiry as a particular behavior could be taught efficiently through television by programed instruction, and that the teaching of inquiry could be empirically validated.

RELATED DATA

Imaginative Uses of Educational Television[1]

JEROME S. BRUNER
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Cambridge, Massachusetts

ONE OF THE THINGS THAT IS QUITE CLEAR ABOUT LEARNING in a school setting is that unless it opens up a fairly large range of alternatives it becomes constricted. The main objective in teaching is to give the learner a picture of the range of alternative points of view or ways of dealing with a problem. One feature of the Physical Science Study Committee's course for high school students is precisely that. It leads the student to a sense of alternative explanations, as in dealing with the properties of light, whether a particle theory or a wave theory. The students end with a justified feeling of unsettledness. Here television is in an extraordinary position. It is not limited to a single teacher, a single theory, nor a single formula. Yet television has squandered this excellence in randomness by substituting variety for alternatives, variety in a riot of different kinds of programs and infinite subjects. But at what depth have the different alternatives on any particular issue been even considered, much less exhausted?

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[1] Presentation at the Brandeis Conference on the Economics of Educational Television, May, 1963.

A second feature of learning and teaching is that you wish not so much to get something into the learner, but to get something out of him. The learner must be tempted to explore and manipulate—must be saved from being bench-bound. But television is often more a spectacle than a tempter to intellectual action. We tempt action, for example, by using such inventions as the laboratory, the discussion, the confrontation—almost anything that will get the learner moving. Television tends to freeze the student before a screen. One solution to overcome this and stimulate exploration might be to give the viewer time to respond. Perhaps silence, enabling the learner to gather his wits and question the speaker's, may very well be a necessary condition for turning television into an educational medium.

Further, the object in teaching is not to force a gob of material into somebody's head, but rather to get that minimum amount that functions to regenerate the rest. It is hopeless to expect a person to long retain a lot of unconnected information. We fight this human weakness by reducing information to a minimum set of propositions that can be used to reconstruct the rest in detail later. An example is science, in which compactness is the ideal. The expression $S = \frac{1}{2} gd^2$ can regenerate all you need to know about the gravitational field here or wherever your spaceship may land. So, too, Acton's "Power doth corrupt and absolute power corrupts absolutely." It cannot reconstruct the Medicis, but it might make it possible to imagine them or even to invent them.

In all condensation, selectivity is essential. But selection is dangerous, not only in leading to risky follies, but in offending common belief. We accept the formulas of physics or chemistry, but in sociology it is not so easy to convince the purveyors of endless, fascinating detail. Imposing simple generative structures of knowledge on a field like sociology involves "bias." But it is inevitable bias. The solution is to present the alternative biases in the hope that at least we have converted the sponge into something more selectively attentive. Given its status as a non-controversial media, the question is whether television is capable of the degree of skillful bias and selectivity to do this structuring well. Of necessity, this will demand sequential programs rather than autonomous individual programs, especially if we are to explore deeply the question of the range of alternatives within one field.

Good teaching encourages discovery on one's own. Research over the last decade indicates that knowledge discovered by the learner tends to be related better to other things, can be better manipulated, transferred and remembered. The intriguing question is, what would happen if the objective of all learning were to encourage discovery—to wait for the child to discover, himself, the rules of English orthography. Though the difficulties are staggering, the extremes idiotic, a proper balance is surely sensible. Too little discovery produces tidy, unquesting minds; too much, and the culture is of no help to the learner. Educational television could play more good games which stimulate the mind to discover regularities. *Information Please* was one of the first successful programs of this type. A similar result was later achieved by *Professor Quiz*. This approach is very useful and obviously challenging—even on commercial television. Educational television, often overcome by its solemn mission of presenting knowledge, seems to have forgotten all this.

Consider dialogue as one way of fomenting discovery. Some of us have had the experience of watching a brilliant math teacher working with children. Most striking is his masterfulness in dialogue with the children; they are never wrong, frequently pose the wrong problem, then answer it. The teacher leads them to reformulation by dialogue. But, interestingly enough, you identify with the participants. You learn, too. Might we not invent techniques of programing that allow a listener to participate in problem-solving in this way? Can you bear a program that does not have a bang "finish"? Our habits run to the "close." Good teachers fight it, knowing that what pays in the long run is to keep the issue open.

Learning cannot occur unless the learner knows the results of his efforts. Feedback, to use jargon, is the heart of the matter. In television teaching, the viewer cannot get such feedback; he cannot know whether he is on the right track. It is wise to admit, therefore, that television is not a completely self-sufficient medium. How can you introduce some feedback technique to assist the learner?

One significant characteristic of television is that it involves symbolic communication and communication by image at the same time. There are three ways in which you can represent knowledge to another. One is by enactive representation; another is by ikonic representation, and the third is by symbolic representation.

What is a running bowline? It is a knot. But that description will not get you very far; so you go to the board and try to draw it, and that is equally difficult. You end by getting a piece of rope and showing how to tie one. So, too, with teaching bicycle riding. You throw your leg over the seat, put your foot on the pedal, and so on. Some things cannot be described by other means.

The second means of conveying knowledge has to do with representation in imagery. Most people say, "I don't have images." But when asked to name the states of the United States, they start to name them—Maine, New Hampshire, Vermont—using a kind of mental map from inside their heads, spatially organized. Spatial imagery runs to concreteness. When asked about a triangle, you recall a particular triangle, a highly concrete image that is hard to transform.

A symbolic representation, on the other hand, is much more transformable, whether you are using ordinary language or the language of mathematics. Language carries transformative rules that enable us to turn things upside down, to negate them, to put them in the conditional, to translate them. This is the glory and weakness of words and symbols. We need images in the head, too. We do much problem-solving in terms of concrete images, often at less depth, but faster than by more exact symbolic manipulation.

The great problem about all media that work in terms of pictures is that they risk being impervious to symbolic manipulation. They cut down the possibility of turning things inside out for purposes of problem-solving. This stuck quality of imagery is one of the things that has not been studied in the television learning process. However, if ever there were a medium that could work on the relationship between presentation of ideas in language and through imagery, television is it. As a device to present fact, it might become one of the more effective methods. Why not experiment more?

Let me finally mention one other thing—intuition. Intuition is usually called "guessing" by the frightened teacher, and she knows that it is not good. Yet it is characteristic of the human condition to reach conclusions without the benefit of all the information: we do not have it, and often it is not to be had. This occurs equally in everyday life and in science. So we have tried in our curriculum efforts to get the students to learn the *art* of guessing, and early. The art of guessing comprises tricks and techniques of non-rigorous proof. In mathematics this is all dignified by the name "heuristics." There are good ways of guessing until you find out whether it is worth computing. It is like life, or history. When someone begins with the view that World War I was started by munitions makers, you want to give him enough heuristic technique to ask himself, "Is it reasonable to stop here, or should I keep looking?" We do this in choosing wives and husbands. Why not trust it in less critical decisions?

Intuition is not merely a luxury of those in the aesthetic realm; it is a general armament of problem-solving. Might ETV present some fine models of great intuiters at work? There are plenty of them, and they are our most engaging and talented colleagues.

To get a good learning, as everybody has said for a millenium, you need a competency model. A competency model is somebody learning something—somebody in the act of learning who gives you some idea of what it is like, though not necessarily showing you how to do it. The Physical Science Study Committee films present a genuine physicist doing a real experiment to give the students an appreciation of the subject. Watching such a competency model at work is one way to make knowledge come alive. For this, television is almost without peer.

What will happen to educational television? Most of its weaknesses, except those of youth, exist because we have neglected its potential and failed to exploit it to its fullest. Most of the other weaknesses arise because the medium aspires to self-sufficiency—failing to join skillfully with other media and techniques. For the future of ETV, the greatest mistake could be to put it to work sanctifying the traditional. Simply filming lectures, panels or seminars ties television to all the blarney of the old academic techniques. ETV needs invention as the school needs invention. Felicitously discovered, television can then serve as the quality control for the entire educational system, building and maintaining taste to a level never before imagined.

Instructional Television and School Curricula[1]

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IN THE EARLY DAYS OF EDUCATIONAL TELEVISION, only a little more than a decade ago, there were those who argued that instructional television offered the solution to such pressing problems as the teacher shortage, overcrowded classrooms, the increasing cost of education, and the improvement of the quality of instruction. Today not so much is heard concerning the use of television as an economy measure. Much more attention is being given toward finding ways in which television can improve the quality of education and bring about greater learning efficiency.

Today, too, we are concerned with finding the proper place for television within the broad range of new educational media which instructional technology is making available. Newer media must not be used as single instruments, but rather as a part of a symphony, with each playing its proper role in harmony, toward the achievement of desired learning objectives, under the direction of a teacher in the classroom.

Any evaluation of the effectiveness of instructional television must always be in terms of the total teaching and learning tasks. When we examine the research on the effectiveness of instructional television, we find, with few exceptions, that most of the evaluation is not in terms of the total teaching-learning process, but only in terms of the effectiveness of the medium in communicating information. In study after study, one finds that the evaluative criteria were limited to only a few aspects of the cognitive area.

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[1] Excerpt from a presentation at the Brandeis Conference on the Economics of Educational Television, May, 1963.

If we are to accomplish our basic purpose in education—to help each student achieve his potential—we must do far more than convert children into robot computers who will store and retrieve facts upon command. We must not underestimate the importance of information-giving, but it is secondary to information-discovery. These goals demand our attention: the processes of concept formation; the ability to infer new information from a given body of facts; the capacity to use facts and principles to explain unknown phenomena; the ability to conduct independent inquiry and to apply logically sound methods of arriving at conclusions.

Any consideration of the place of instructional television must recognize that the medium has strengths and limitations in terms of each individual pupil. Children are stimulated and motivated in different ways; they learn at different rates; their processes of conceptualization vary greatly. Children learn different things from exposure to the same body of content, and in every situation there are concommitant learnings on the part of each individual which influence how he feels about what he learns and how he behaves as a result of how he feels.

Here we find ourselves in the *affective* domain, and here there is little reported research to guide us. What is the effect of instructional television in developing positive attitudes toward learning, in promoting wholesome interpersonal relationships, and in formulating value systems? These are generally unanswered questions, but they represent the kind of questions to which we must find answers if we are to use this medium fully.

Problems in the Area of Programing

When we examine critically the use of instructional television in some of our schools today, we are forced to admit that we have unsolved problems in the area of programing.

We have too often assumed that televised teaching must be patterned after traditional classroom teaching. We have attempted faithfully to reproduce on television the methods and techniques we have found to be successful in the classroom. The television teacher dispenses information, he lectures and explains—and all too often fails to take full advantage of the potential of the medium.

We are not yet making full use of instructional television in stimulating critical thinking and problem-solving. With an everaccelerating rate in the discovery of new knowledge, learning becomes increasingly a lifelong task. We have the responsibility of helping children develop the skills of critical thinking which will enable them to cope with problems which are as yet unknown. We must help children develop positive attitudes toward learning itself. In short, helping students "learn to learn" may well be one of the major tasks of education.

How well are we doing in instructional television in developing skills of critical thinking and problem solving, and in stimulating a positive attitude toward learning itself? An examination of existing programs is not encouraging. Too much television teaching has been *indoctrination* rather than *education*. All too often, the only viewpoint presented is that of the television teacher, whose perceptions and conclusions are presented as final and "the last word"—not open to question or further exploration.

The fault lies not in the medium, but in our use of it. Television "lessons" need not be neat, self-contained packages containing selected data, preconceived conclusions and established generalizations. Lessons could be planned to present opposing points of view on both current and historical problems, to sharpen issues, and to encourage the student to arrive at his own interpretation of the evidence.

This kind of lesson, completely open-minded, could serve as a springboard to vital class discussion, to concentrated library research, and to the study in depth of significant problems. Because students differ greatly in abilities and interests, all would not be expected to pursue a subject in the same way or to the same depth—the very nature of the open-ended program would broaden the opportunities for the classroom teacher to differentiate activities, assignments and follow-up procedures.

We have not yet fully solved the problem of getting interaction between the television teacher, the classroom teacher, and the individual learners. Interaction, as we are concerned with it in a discussion of instructional television, involves much more than two-way communication. We are concerned with interaction between television teacher and classroom teacher, between television teacher and student, between classroom teacher and student, and among students. All of these relationships influence learning. We still have a great deal to learn about the role and the importance of interaction in the learning process; the implications for instructional television are of major concern.

Guidelines for Improving Instructional Television Programs

Learning from instructional television is likely to be more effective when—

— the program promotes inquiry, stimulates children to think critically, raises questions rather than gives answers, poses problems, opens up a large range of alternatives or differing points of view or ways of dealing with a problem. It should spark the learner's curiosity to want to know more about the topic.

— the learner is helped to perceive things differently and his behavior is changed as a result.

— the goals and purposes for learning are clearly perceived by the learner and have relevance, usefulness, and personal meaning to him.

— the learner is a rational participator rather than a passive receptor and is himself involved in the learning situation.

— the learner is given opportunity for interaction with the teacher and with other students.

— the learner is led to make decisions as the program progresses. It follows that learning cannot occur unless the learner knows the results of his efforts.

— the learner is sufficiently motivated to continue learning when the program is over, realizing that learning is a lifetime proposition and that uncovering the subject may be more important for the learner than covering the subject. Opportunity should be given the learner to explore the subject later on his own.

— the program explores in depth a segment of the topic—or each of the alternatives of an issue—rather than surveys superficially. "Postholing" adds to the quality of the learning experience.

— the learner sees the whole of which this bit of information or topic is a part. Instead of building small bits of information into a larger pattern, the nature of television is such that the nature of the whole can be presented as a backdrop to consideration of its parts.

— the program enables the learner to feel a high degree of identification with his TV teacher and with other learners.

— that which is being learned is supported and reinforced by other contacts, experiences, and media and when one medium is not seen in isolation of other resources but in orchestration with them.

— the learner is helped to see *relationships* between bits of information and slices of reality.

— the learner is provided with raw data on the television screen from which to make generalizations rather than be given the conclusions.

— different methods and approaches are used within a program or series of programs. No one best way is equally suited to *all* learners. Different objectives for learning require different principles and methods.

— the clues are not clear; their ambiguity requires the learner to give his own interpretation.

In implementing the above principles, more attention needs to be given, in the design of instructional television programs, to providing—

■ more presentation of raw data and less presentation of conclusions

■ more ways in which pupils can participate during the program

■ more ways of obtaining feed-back during the program

■ more posing of problems and raising of questions

■ more pauses—silences—for assimilation

■ more cliff hangers

■ more statements that cause children to think and do something in response

■ more open ended programs

■ more studio demonstrations

■ more visualizations, less commentary

■ more use of resources which are outside the range of the classroom

■ more pacing to fit maturity level of learners and the content which is being developed.